

## Attachment 4: Project Description

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### DETAILED PROJECT DESCRIPTION

This project will develop a groundwater management tool that is needed by Zone 7 to assist in managing the Livermore Valley Groundwater Basin. The proposed project will accomplish some major upgrades and improvements to Zone 7's groundwater model for its use in evaluating groundwater, and salt management strategies and alternatives, as well as for the development of specific project plans that involve groundwater supplies, aquifer storage and constituent transport.

Salt management is an important issue in the Livermore-Amador Valley where Zone 7, as the overall groundwater management agency, is responsible for maintaining a sustainable and reliable water supply. Despite practicing sensible surface water importation, conducting artificial recharge with imported water containing low total dissolved solids (TDS), limiting groundwater pumping, and managing wastewater disposal and recycled water use within the watershed, there has been a gradual degradation in water quality through the accumulation of "salts" from the various sources. The net effect of the aforementioned management practices on the salt loading from urban and agricultural irrigation over the groundwater basin, natural and artificial stream recharge, and subsurface inflow of poor quality water into the basin, has resulted in an average salt loading of approximately 2,000 tons per year since 1974, and an average TDS increase from 450 mg/l to 650 mg/l (Zone 7 Water Agency, 2012).

Net salt loading has decreased slightly over the last two years since the operation of Zone 7's newly constructed groundwater desalination facility; however, salt loading is projected to increase as the Valley becomes more urbanized and the use of recycled water increases. Zone 7 is currently updating its Salt and Nutrient Management Plan to meet requirements of the State Water Resources Control Board's Recycled Water Policy, and to include updated local land and water development plans. The use of a reliable groundwater model would be helpful in predicting the effects of these future plans, and to further develop Zone 7's ongoing and future salt management strategies. In addition to its value for salt management purposes, a refined groundwater model would be a beneficial tool for the planning of Zone 7's future groundwater development projects and conjunctive use operations; for the management and mitigation of nutrient impacts in the basin; and for the evaluation of various managed aquifer recharge (MAR) project opportunities that are presented by the imminent granting of several gravel quarry pits to Zone 7 by the local gravel producers in accordance with their reclamation plans.

Zone 7's current Livermore Valley Basin Model contains three active layers that represent two aquifers, an upper unconfined aquifer and a lower confined aquifer that includes the many productive intervals used by local municipal wells, and an intervening aquitard. The model grid is composed of uniform 500-foot squares in the X and Y direction and varied in the Z direction according to mapped thicknesses. The outer boundaries of the active model cells encompass the Bernal, Amador, Mocho II, Castle, Dublin, Camp and Bishop Subbasins (see Figure Att4-1 for model location). The model utilizes the three-dimensional MODFLOW-SURFACT numeric code (Panday and Huyakorn, 2008) to simulate groundwater flow, and simulate solute (salt) transport in the basin under specified stresses.

The Livermore Valley Basin MODFLOW model was originally created in 1996 by CH2M Hill as a conversion of an older three-dimensional finite-difference model developed in the 1980's to evaluate potential groundwater management policies for the Livermore Valley Groundwater Basin. The 1996 version was calibrated with historic water level data (1976-1995), and used to simulate various salt loading scenarios and salt management strategies during the development of Zone 7's Salt Management Plan (EOA/Zone 7, 2004). This model version was also used in Zone 7's Well Master Plan effort to assess the impacts of installing and operating additional municipal supply wells (CH2MHill, 2003).

In 2005, HydroMetrics LLC recalibrated the model (this time using groundwater elevation data from 1974 to 2004) using PEST to vary the model's hydrogeologic properties to represent heterogeneity. The model was used to evaluate alternatives for sizing and siting potential future groundwater desalination facilities as an effective means to remove salts from the basin and potentially restore groundwater quality (Rooze, 2006).

Although the model was not calibrated either time using historical TDS concentrations, it was used previously to simulate the transport of TDS with the assumption that TDS represents salts and acts conservatively (i.e., non-reactive) during its transport. This approach is generally good for qualitative comparisons, but not as good for predicting probable TDS concentrations. Zone 7 now desires the ability to predict the approximate salinity consequences of various projects, actions, and basin management strategies for groundwater sustainability.

Solute transport modeling generally requires more model layers than groundwater flow modeling. Layers that represent the basin's gross hydrostratigraphy may be too thick to accurately represent the depth variation of salt concentrations. Accordingly, the proposed project will implement various structural upgrades to the model for its use in

evaluating groundwater, salts, and nutrient management practices and plans. The model layers will be refined and/or subdivided to better represent clay overburden in the southwestern portion of the basin and the variability of well screen placements and TDS concentrations with respect to depth in the lower aquifer. The delays in vertical solute transport between the surface and upper aquifer provided by the low conductivity overburden, and from the top to the bottom of the lower aquifer provided by the heterogeneity within the lower aquifer unit need to be dealt with in order to achieve successful calibration with the available historical well data.

Another proposed structural upgrade for the model is the addition of Stream Flow Routing (Streams) and Lakes packages to represent the arroyos and quarry ponds in the valley, and to simulate their roles in solute transport and groundwater recharge. The current model does not explicitly simulate stream routing or lake water budgets; however, upgrading this portion of the model will allow direct simulation of flow interactions between these groundwater and surface water features as they are important features for moving salt into and around the Livermore Valley Groundwater Basin. Neither the proprietary code MODFLOW-SURFACT nor MT3DMS (Zheng, 2010), the public domain fate and transport code that works with MODFLOW, currently support solutes transport in lakes and streams. However, in another related effort, Zone 7 is funding the development of this software capability for MT3DMS, which should be ready for use by the anticipated start of this project. Zone 7 is also funding the conversion of the model from MODFLOW-SURFACT to open source versions of MODFLOW and MT3DMS to take advantage of the new software capability.

Apart from these structural updates to the model, the model time period will be extended through 2012, from its current end period of 2004. Monthly production, irrigation, and recharge data will be compiled and imported into the model. After the model has been updated and extended, it will be recalibrated, using existing and added 2004-2012 groundwater level data, salt concentrations, and streamflow. The Parameter Estimation (PEST) software will be used to calibrate hydrologic parameters that vary spatially over the basin area similar to the 2005 calibration. Calibration will be judged on both visual inspection of groundwater hydrographs and chemographs; as well as statistical analysis of model results. Calibration will continue until both Zone 7 staff and the consultant staff agree that the model results are adequate for updating the Groundwater Management Plan (GWMP), and for groundwater and salt management. The calibrated model will also undergo peer review by a groundwater modeling expert.

The upgraded and calibrated model will be applied to simulate scenarios pumping and recharge activities in the basin while improving salt concentrations. Three groundwater and management scenarios will be developed and run by the model. Optimization of

one of the scenarios using the model will be set up and run. One possible optimization scenario includes maximizing salt removal while maintaining groundwater levels above benchmarks such as historical lows. These scenarios will assist Zone 7 staff with implementation of its Salt and Nutrient Management Plan, and provide Zone 7 staff with a “roadmap” and enough experience with optimization runs that they will be able to perform future runs without the need for outside consulting services.

## **PROJECT GOALS**

The goals of this project (Upgrades, Calibration, and Application of Zone 7's Groundwater Model for Groundwater and Salt Management) are:

- Goal 1: Calibrate the model to effectively simulate current conditions.
- Goal 2: Use the model for ongoing groundwater and salt management and project planning efforts
- Goal 3: Use the model for optimizing groundwater storage, production, and recharge.

## **SUPPORTING THE GOALS OF THE GWMP**

The proposed project directly supports both the goals and the basin management objectives (BMOs) of the Zone 7 Groundwater Management Plan (GWMP). The GWMP goals supported by this project include:

- to maintain the balance between the combination of natural and artificial recharge and withdrawal;
- to maintain water levels high enough to provide emergency reserves adequate for the worst credible drought;
- to protect and enhance the quality of the groundwater;
- to develop information, policies and procedures for effective long-term management of the groundwater basin; and
- to inform the public and relevant governmental agencies (e.g., the Tri-Valley Retail Group [TVRG], which includes DSRSD, CWS, Livermore and Pleasanton) of Zone 7's water supply potential and management policies, and to solicit their input and cooperation.

Use of the upgraded and recalibrated model will support the following Basin Management Objectives (BMO) in the GWMP:

- Monitoring and maintenance of groundwater levels through conjunctive use and management of regional water supplies:
  - Such as, allowing for gravel mining by optimizing groundwater levels to allow for gravel mining while maintaining adequate reserves for municipal supply, and
- Prevent overdraft conditions by maintaining total pumping at or below sustainable/safe yields;
- Groundwater quality—monitoring and management, as well as tracking and addressing any degradation:
  - protect and enhance the quality of the groundwater,
  - halt degradation from salt buildup,
  - reduce flow of poor quality shallow groundwater into deep aquifers,
  - recharge with relatively low TDS/hardness imported or storm/local surface water, and
  - manage quality on a regional basis as measured at municipal wells (such as those operated by both the retail water agencies and Zone 7), protecting and improving groundwater quality within the Main Basin;
- Monitor and prevent inelastic land surface subsidence from occurring as a result of groundwater withdrawals:
  - protect the storage capacity of aquifer, and
  - maintain groundwater levels above historic lows;
- Optimize use of storage while protecting and enhancing groundwater goals.

The upgraded and calibrated groundwater flow and transport model directly supports the goals and objectives of the GWMP by providing a tool to simulate groundwater levels, groundwater quality, and potential management actions that are needed to implement the plan.

### **SUPPORTING THE GOALS OF THE IRWMP**

Apart from supporting the goals and objectives of the GWMP, as discussed above, the project also supports the goals and objectives of the Bay Area Integrated Regional Management (IRWMP). The specific goals supported are:

Goal B – Contribute to improved supply reliability

- Preserving highest quality supplies for highest use,
- Protecting against overdraft,
- Providing for groundwater recharge while maintaining groundwater resources, and
- Increasing opportunities for recycled water use consistent with health and safety.

Goal D – Contribute to the protection and improvement of the quality of water resources

- Reducing salinity-related problems.

### ONGOING USE OF DATA

The model will be used regularly by Zone 7 staff to optimize pumping, artificial recharge, and salt mitigation in the groundwater basin. It would also be used to simulate the effects of specific management actions, such as changing the quality of imported recharge water, redistributing pumping from wells, assessing well master plan siting of wells, and maintaining groundwater elevations above historical lows. The continual use of the model as a management tool by Zone 7 staff would be funded from its Groundwater Group budget. Zone 7 can fund future updates using water rates and expansion funding.

The model is planned to be updated every seven to ten years. This ensures the model remains calibrated to current data and takes advantage of new and improved modeling packages that may be published by the USGS.

### COLLABORATION WITH STAKEHOLDERS

Zone 7 operates under the basic philosophy of working cooperatively with the public, the four individual retail agencies (Dublin San Ramon Services District [DSRSD], City of Livermore, City of Pleasanton and the California Water Service Company [CWS], collectively known as the Tri Valley Retail Group [TVRG]), and urban and agricultural irrigators. Objectives for collaboration include:

- to accurately depict past, current and future water supply and salt loading fluxes in the groundwater model scenarios;
- to develop information, policies, and procedures for the effective long-term management of the groundwater basin ensuring its sustainability as a public drinking water supply while minimizing fees and rates;

- to inform the public, retailers, and other relevant governmental agencies of the Zone's water supply plans and management policies and to solicit their input and cooperation;
- to work cooperatively with the gravel mining industry to implement the Chain of Lakes reclamation plan for converting the gravel pits into water storage and recharge facilities; and
- to support recycled water expansion by the retailers.

Zone 7 will meet and collaborate with the TVRG to collect past and future model input datasets and to identify future groundwater and salt management scenarios to model. Draft reports will be provided to the Tri-Valley Retail Group and made available to the public for comment. Final reports will be provided to the stakeholders to be used as a reference during groundwater management and salt and nutrient management activities.

Upon completion, the project report will be made available on Zone 7's website at: <http://www.zone7water.com/publications-reports/water-reportsplanning-documents>

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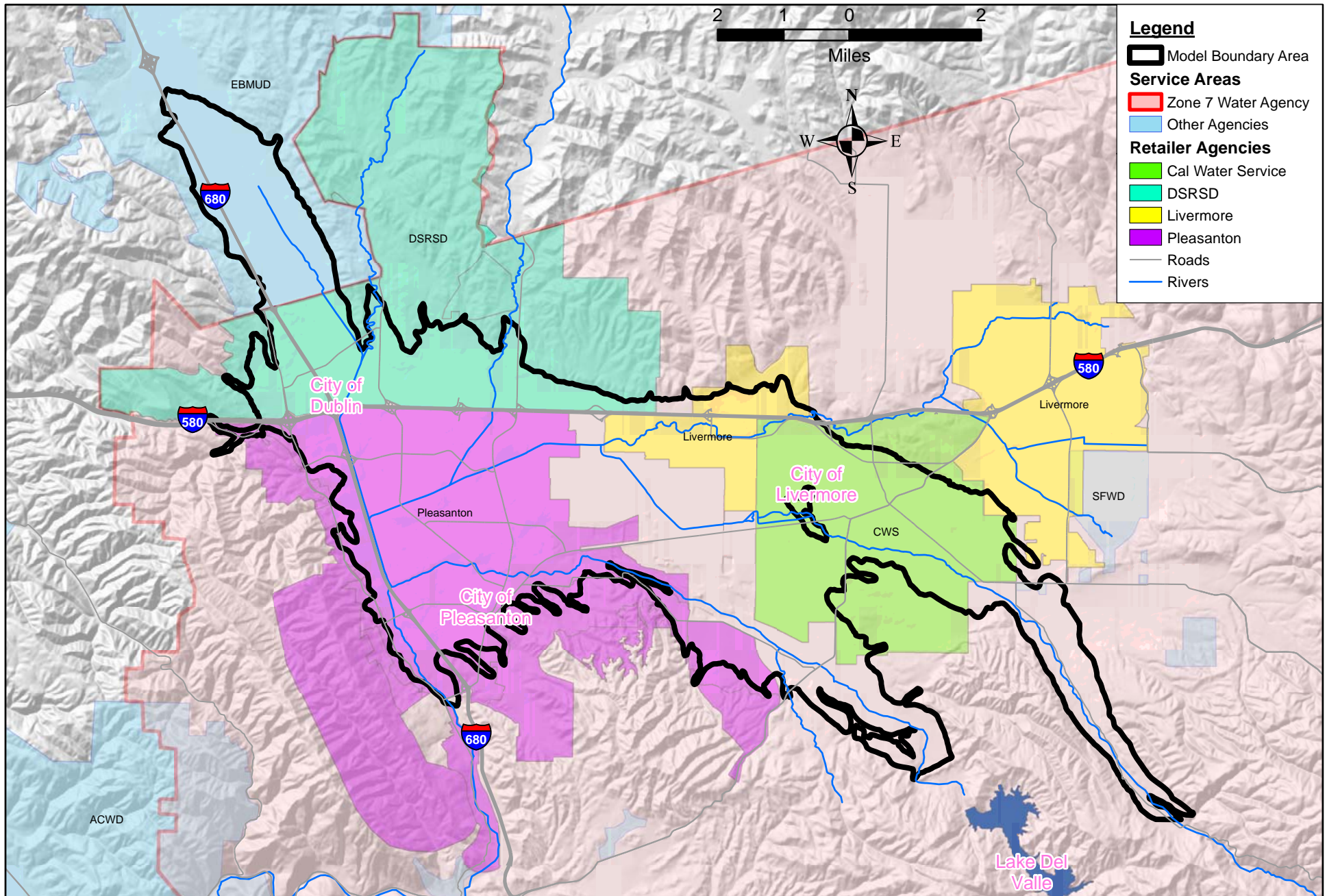
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DRAWN: TR

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File: E:\PROJECTS\LGAGrantStudy2012-Model\  
FigAtt5-1-ModelArea.mxd

**MODEL LOCATION  
LIVERMORE VALLEY  
GROUNDWATER BASIN**

Scale: 1 in = 2 miles

Date: July 12, 2012

FIGURE Att4-1